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MEMORANDUM ON INSECT AND TWIG BLIGHT INVESTIGATIONS AND STUDIES - 1936

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BERKELEY, CALIFORNIA
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MEMORANDUM ON INSECT AND TWIG BLIGHT INVESTIGATIONS AND STUDIES - 1936

The following memorandum is a brief resume of field and laboratory observations and activities with regard to the presence of a scale insect, Matsucoccus sp., infesting ponderosa pine in Arizona, and with regard to the possible connection of this insect with the so-called "twig blight" resulting in the flagging of pine twigs.

In late April, a field conference on the problem was helad at Prescott, Arizona, attended by Messrs. Miller, Carter and Randles, Drs. Craighead, Morrison and the writer. During this period, April 23-27, general observations were made and a program tentatively laid out to be followed by Dr. Morrison and the writer. Dr. Morrison remained at Prescott until the second week in May, and the writer until the 26th of the month. This limited time did not permit as much investigative work as possible may have been desirable, though information secured with regard to Matsucoccus will be of considerable future benefit.

Matsucoccus

According to Dr. Morrison, the scale investigated belongs to the genus Matsucoccus, and is probably a new species yet to be described. Insofar as is known at present, the genus is confined to hosts of the genus Pinus. Pinus ponderosa is the chief tree in northern Arizona and studies were centered on this host, altho what appeared to be another species of Matsucoccus was found on Pinus edulis and P. monophylla. The "twig blight" has been recognized only on ponderosa pine.

Little information is available on the life cycle of Matsucoccus. When field observations were first made in the vicinity of Prescott, the scale was for the most part in the egg stage with young larvae soon appearing. Eggs are found in a secreted white woolly mass about the body of the female and within a sac formed by the abdomen of the gravid female. The majority of these woolly masses are located at the nodes of the pine twigs and branches, no mass being found further down the branch than the 1934 node. Occasional masses were found in the internodal region (Pl.I,II,p.6-7) Overwintering takes place in the immature stage where the body is sac-like. These overwintering forms are ound for the most part in the internodal region and about the node where the needles have been shed the previous fall. This statement is based on general observation and not actual counts. Some immature bodies can be found out to the terminal of the twig. Since the egg-laying females are definitely more concentrated about the nodes than are the immature forms it would appear that some migration must take place when the females first appear. In a few instances it was noted that the female failed to emerge from the immature sac, and secreted the woolly mass in place. Such instances were likely due to the inability of the insect to crawl out from the cast immature sac. For the most part these sacs were found under edge of the bark scales and bracts adjacent to needle scars. Grouping of the immature forms was commnn often with some individuals well concealed only to be uncovered by removing the scale or bract. Since these bodies were mostly about the upper side of the needle scar it would appear that the larvae had settled to feed in that position.

Survey of Distribution

Although no systematic study of the distribution of this scale was made, considerable information was gathered from general observation. Particular attention was paid to the distribution of the scale relative to the distribution of the "twig blight". Scale was found in twigs from all areas where the "blight" was present, including numberous locations on the Prescott National Forest, Oak Creek and Baker's Butte on the Coconino National Forest, the Sitgreaves National Forest and the Gila National Forest in the vicinity of Silver City, N.M. In addition, scale was found on material from the Polica Canyon areas of the Santa Fe National Forest, New Mexico, and from an area 4-5 miles south of Reserve, New Mexico, on the Apache National Forest. No "twig blight" or flagging has been found to date in either of these two localities. Material from the Apache, Santa Fe and Gila National Forests was supplied through the cooperation of the Office of Forest Pathology under the direction of Dr. Long of the Albuquerque office. Sufficient material was not examined to make the positive statement that the scale occurs on the Prescott, Coconino and Sitgreaves nowhere but in "blighted" areas but indications are strong that such is the case. The areas on the Coconino and Sitgreaves are decidedly isolated. Examination through the surrounding country failed to show any scale which was easily found when the "blighted" areas were reached.

On the Prescott Forest numerous cases of correlation of distribution of scaleand "blight" were tentatively established. This correlation applies for areas as a whole however, and not for individual trees. As far as examination went it was shown that scale was invariably present on "blighted" twigs. In addition, there was found abundant scale on "blight" free trees. On "blighted" trees the scale was if anything more abundant on healthy branches than on flags. This conditionmmight of course be explained by the fact that many of the flags had appeared by the time that the female scales emerged and on flagged branches the conditions would certainly be less favorable for oviposition. The heaviest scale infestation, as evidenced by egg masses, were found on small, poorly growing and stunted trees, in many cases severely injured by tip moth or mechanical injury. Flagged twigs were rather common on such trees.

Experimental Work

In order to follow the effect of scale infestation on pine branches a small experiment was set up at two localities in the vicinity of Prescott. Small, thimble-shaped cages were constructed of cooper mesh wire. Into these were placed approximately 20 egg masses from material collected at several places in the field on the Prescott, Coconino and Sitgreaves National Forests. These cages were then fastened to pine tips on selected trees. (Pl.III, P.8). Three trees were selected in the Lynx Creek areas a short distance above the CCC camp, where the scale occurs naturally. On one of the three trees females and eggs were present at the time that the set up was made. Notation was made as to the intensity of the infestation in the latter case. In this area cages were placed at the base of the current

season's growth only, 15 cages on the tree already infested, and 30 and 20 cages on the other two trees. Observation was made as to height, growth condition, previous injury, exposure, etc. of the trees so treated. A second area was selected for experimental work on the Copper Basin Road at the junction of the Cold Spring Road. Very little blight has been found in this region in the past and no scale woolly masses were found when the work was started. At this spot cages were placed on seven trees. On six of these 20 cages each were placed, at the base of the current year's growth as was done at Lynx Creek. The seventh tree was heavily loaded with approximately 185 cages. Of this number 100 were placed on the 1936 nodes, and the remainder on older nodes to simulate the field conditions where egg masses are found on nodes other than that of the current year. Sufficient uninfested nodes were left to act as a check on this tree. Examination on several occasions showed that egg hatching was taking place and the young larvae were crawling about. Many of the eggs collected in the Prescott area were hatching at the time the cates were located, but the material from Baker's Butte (elevation 8100 feet, as contrasted with Prescott, around 6000 feet) was still in the egg stage as late as the 20th of May.

Examination of natural infestation as well as of a few caged tips which were brought back to Berkeley showed that many of the larvae had successfully started feeding. It was found that the majority of the larvae had settled down to feed in the immediate vicinity of the egg mass, both in the case of natural infestation and caged tips. These larvae are very tiny and difficult to locate owing to the fact that their body color blends so well with the color of the twig. The larvae were located in groups up to 15-20 in number under the bract enclosing the base of the needle. To find the larvae it is necessary to remove part of the bract. The beaks of the insects are inserted in the very base of the needle, and a group of larvae apparently tend to face inward so that their beaks are inserted in a small area. A photograph of a group of these larvae has been secured (Pl IIId, p.8). Altho the scale are not distinctly shown, the outline of their bodies is sufficiently clear to designate the feeding locality, part of the bract covering the scale have been removed. In a few instances individual larvae were found feeding a bit more removed from the egg mass, as much as 6 inches in one case. Altho the number of examinations made was small, the indications are that any considerable migration does not occur and that the feeding takes place within the bract at the base of the needle. Some larvae were found on the upper sides of the tips, altho all the cages were placed on the under side where the egg masses occur naturally for the most part. The above applies only to larvae from egg masses about the base of the current growth. In several cases of natural infestation about the previous year's node groups of larvae were found feeding under a bark scale just above the needle base. No information was secured as to the feeding of larvae where the needles have already fallen. This information is somewhat sketchy, owing to thelack of time to pursue a thorough investigation but at least gives some indication as to the feeding habits of the young larvae and ties in with the fact that the immature scale bodies of older infestations are found in groups in similar localities.

It would seem apparent then that larval feeding will occur all along the infested twig at least as far back as the third node, providing that the node has had egg masses about it, and that the feeding will be somewhat concentrated about the nodal regions. Further investigation of caged tips should of course be made at some subsequent date and counts made to determine the relative abundance of scale on the various sections of the twig. A considerable amount of material was shipped to Berkeley and can be examined when the opportunity arises. It is expected that the scale will die *in situ* and can be located later on. Such is shown to be the case already in several instances. The determination of the limits of migration is of considerable importance. It is evident, however, that in many cases that a given internode of a twig may be fed upon by the larvae of at least three successive generations, thus aggravating whatever the effect of the feeding may be.

Considerable time was spent in laboratory and field examining infested material to determine what damage was caused by the scale feeding. In many cases it was shown that a resinging area existed under the spot where a group of scale had fed. Lesions could not be found, however, in association with every group of bodies. One such lesion is shown in Plate IIc, p.7, and is typical of others examined. If any definite such lesioning is associated with the scale activity it should be possible to demonstrate this by histological work.

Counts were made on the location of a large number of egg masses on branches collected at Baker's Butte 190 masses were counted on the current node, 183 on the 1935 node (that is the point of origin of the 1935 growth) and 22 on the 1934 node, with an insignificant number occurring in the internodal regions. Since there are obviously a much greater number of 1936 nodes the results if anything show a preference for the second node. Since these counts were not based on branches that were systematically cut back of the 1934 node, it is probably best to state that egg masses are at least as abundant on the second as on the first node.

Because of the limited time for this investigation much of the work which had been planned was not completed. With reference to Dr. Craighead's memorandum of May 7, 1936, the status of work done is as follows:

1. Collecting of egg masses and placing on selected trees was carried out as described above.

2. No other individual twigs heavily infested with scale egg masses were marked for subsequent examination, but

3. Areas now heavily infested have been noted by the writer and should be checked another season to determine what injury has occurred.

4. The writer has made no arrangements with regard to securing specimens from the Prescott area. It is understood that this will be taken care of from Washington.

5. Considerable amount of material has been preserved in a wood fixative for histological work if such is desirable. Owing to lack of time much of this material has selected at random. If the occasion arises it would be most advisable to sit down in the field and select the best specimens which can be obtained for such work. The time necessary to do this would be well justified. Since the writer will not be in the Berkeley laboratory during the field season, it would perhaps be best if any material for sectioning were selected in Washington, fixed there, and shipped to Berkeley.

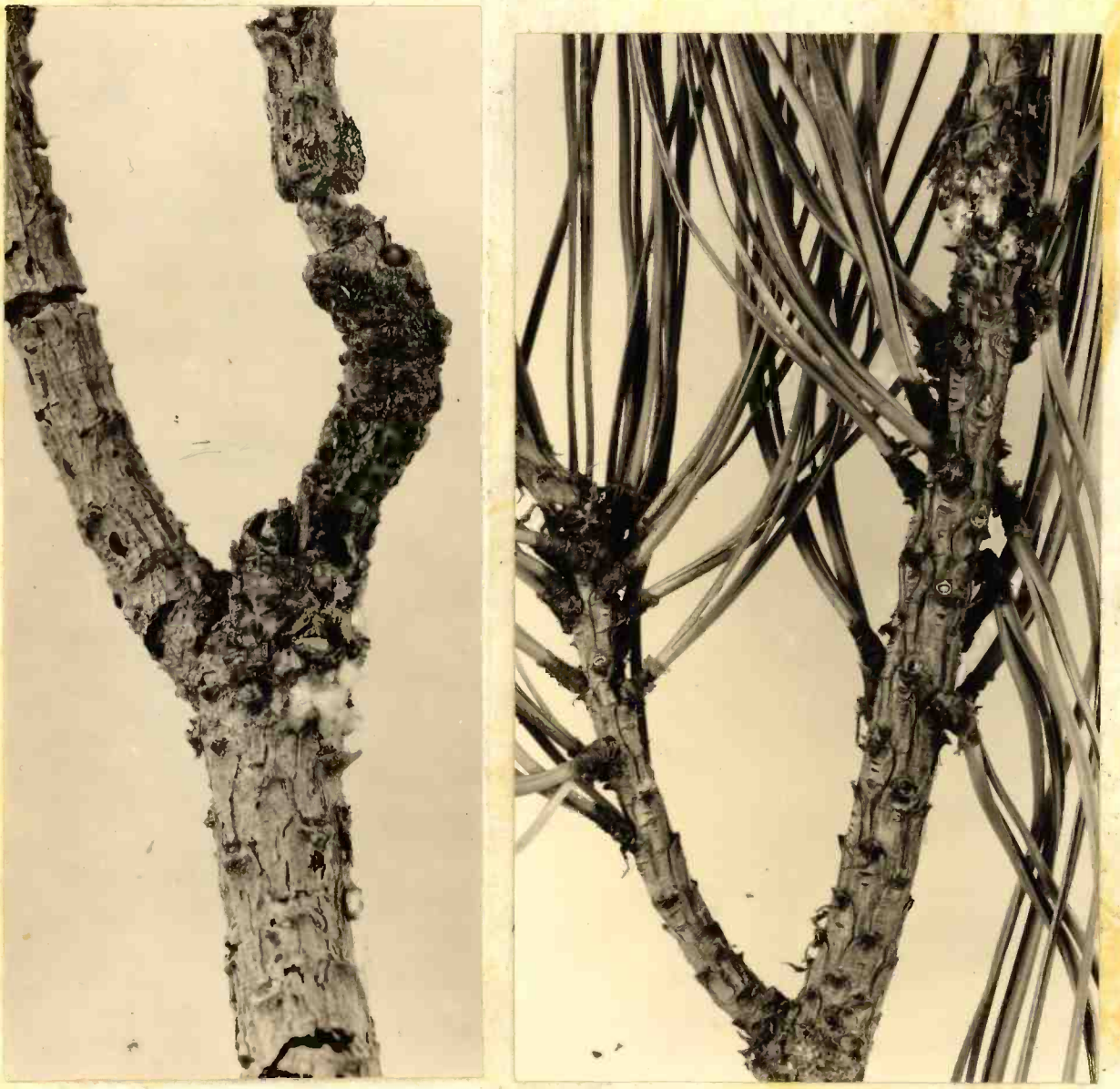
6. No spraying experiments were carried out.

7. The determination of distribution has already been discussed.

8. A number of twigs were mutilated by scraping the bark down to the wood on various internodal regions of branches, the area selected being scale free.

Berkeley, California
June 2, 1936

A. W. West, Jr.
Field Assistant



a b

Plate I - Matsucoccus matsumurae. Examples of location of females within woolly secretion on ponderosa pine. Material from Prescott National Forest, April, 1936. Photo by J. E. Patterson.

a

b

c

Plate II - Matsucoccus matsumurae. (a and b) examples of location of females within woolly secretion. Prescott National Forest, April, 1936. (c) resined lesions above which group of scale bodies were located. Typical of examples found. Photos by J.E. Patterson.

a

b

c

d

Plate III - (a,b,c). Trees used for caging females and egg masses to induce heavy infestation of Matsucoccus. White bodies on trees show position of cages. Copper Basin Road, Prescott National Forest. Phot by A. S.West, Jr. (d) Position of young scale larvae after migration from egg masses. Arrows point to scale bodies where sheath of needle fascicle has been removed. Photo by J. E. Patterson.